PHOTO-IDENTIFICATION OF THE KOREA-OKHOTSK GRAY WHALE (*ESCHRICHTIUS ROBUSTUS*) POPULATION ALONG THE NORTHEAST COAST OF SAKHALIN ISLAND, RUSSIA, 2003

Final Report

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INTRODUCTION

There are currently two gray whale (*Eschrichtius robustus*) populations: eastern (California-Chukotsk) and western (Korea-Okhotsk). Population estimates of eastern gray whales peaked in 1999 at more than 26,000 (Rugh et al. 1999), however recent estimates in 2001/2002 estimate the population is approximately 18,000 individuals (Rugh 2003). In November 1991, by resolution of the US National Oceanic and Atmospheric Administration, the eastern gray whale was removed from the endangered species list, which had been its status since 1967.

In contrast, western gray whale numbers are not paralleling those of eastern gray whales and the conservation status of the Korean-Okhotsk gray whale population is receiving increased attention in recent years (Webster 2003). The Red Book of the Russian Federation has listed the western gray whale as an endangered (Category I) species (Perlov et al. 1996, Red Book of the Russian Federation 2001) and they are also considered endangered by the United States government (USFWS 1997). Presently, western gray whales are considered by the IUCN to be critically endangered (Hilton-Taylor 2000, Weller & Brownell 2000). The IUCN Red List criteria used to support this reclassification were as follows: (1) the population is geographically and genetically distinct (LeDuc et al. 2002), and (2) the population plausibly contains less than 50 reproductive individuals (Hilton-Taylor 2000, Weller & Brownell 2000, Bradford 2003).

Much of the gray whale life cycle takes place in the coastal zones of densely populated countries with intensive fishing and shipping. Western gray whales are vulnerable to hazards at all three life stages: (1) during whale reproduction in the southern part of their range, the location of which is presently unknown, (2) during prolonged northerly-southerly migrations, the route which is presently unknown, and (3) in their known feeding areas off the northeast coast of Sakhalin Island, Russia. Historically, the distribution of gray whales in the Okhotsk Sea apparently included Sakhalin Bay (west of the NW end of Sakhalin Island), Akademiia, and Tugurskii bays south of the Shantarskiy Islands (in the far western Okhotsk Sea, west of the NW end of Sakhalin Island), the coastal waters of northeast Sakhalin Island, in Shelikhova, Penzhinskaya and Gizhiginskaya bays in the far northeast portion of the Okhotsk Sea, and in the waters west of the Kamchatka Peninsula (Krupnik 1984, Yablokov and Bogoslovskaya 1984, Perlov et al. 1996). The long-held belief that their wintering grounds were along the south coast of the Korean Peninsula has not been recently substantiated (Rice 1998). Wintering grounds are now believed to be located in the South China Sea, possibly along the coast of Guangdong province and/or around Hainan Island (Rice 1998). However, specific calving sites have never been observed. In addition to potential impacts on the whales from increased vessel traffic connected with intensive fishing and commercial and recreational navigation, the countries of East and Southeast Asia still have strong traditions for consumption of whale meat (Lento et al. 1998, Wang 1998).

Photo-identification (hereafter referred to as “photo-id”) of marine mammals has proven to be a useful tool for monitoring wild populations of animals while minimizing impact on individuals. When incorporated into a long-term monitoring program conducted for

several years, photo-id can be a valuable tool to answer many ecological questions about populations of marine mammals. For small or closed populations, it has been used as an effective method for estimating population size and change over time (Whitehead et al. 1997, Cerchio 1998, Stevick et al. 2001, Bradford 2003, Weller et al. 2003ab, Calambokidis and Barlow 2004). For large whale populations, photo-id has been used to establish long migration routes (Best et al. 1993, Darling et al. 1996, Craig and Herman 1997, Salden et al. 1999, Weller at al. 2002), feeding ranges and interannual changes in whale distribution (Calambokidis et al. 2002). For these large whale species, photo-id can also be used as a method to examine health indicators of individuals, as well as the general health of groups and populations (Pettis et al. 2004). Photo-id methods have proven extremely useful for gray whale studies (Darling 1984, Jones 1990, Weller et al. 1999, Calambokidis et al. 2002), as individuals are particularly well marked along their sides, backs, and flukes.

Coastal areas are often acute conflict zones (Goldberg 1993) and since photo-id is often the only method to available to record external health indicators of animals. In many cases, photo-id of whales in regions with an elevated level or risk of anthropogenic impact on the natural environment (coastal cities with industrial and domestic wastewaters, oil development, intensive fishing and shipping, large-scale mariculture, mass tourism) can help to resolve some conflicts. The important role of photo-id in population monitoring and timely signaling of the appearance of negative phenomena may sometimes prevent conflict or reduce the intensity of it.

OBJECTIVES

Sakhalin Energy Investment Company Limited (SEIC) and Exxon Neftegas Ltd. (ENL) are currently developing oil and gas reserves in the Okhotsk Sea off the northeast coast of Sakhalin Island, Russia and other companies are poised to begin developing reserves in this area. Oil and gas development in proximity to western gray whale feeding areas along the northeast coast of Sakhalin Island, especially during the spring to fall migration and feeding period, could negatively impact western gray whales if not adequately mitigated. The photo-id work is a key monitoring strategy to provide input to the need and design of mitigation strategies and to monitor their effectiveness.

The technical objective of the work was to conduct photo-id to assess annual return rates and patterns of site fidelity for known individuals, which will contribute to defining the size, structure, and status of the population in general. Photo-id can be used to understand various aspects of western gray whale ecology such as:

- Number, status and habitat use of cow/calf pairs (calf production/survival);
- Number of individual whales observed;
- Population demographics and structure;
- Number of re-sightings of individual whales (within and between feeding seasons);
- Patterns of individual whale movement;
- Association patterns between individuals;

- Site-fidelity and interchange between feeding sites;
- Individual Health Indicators;
- Population Status; and
- Individual foraging patterns and individual site-selection preferences.

BACKGROUND

Two primary gray whale feeding areas have been identified off Sakhalin Island. A shallow (generally <20 m deep) feeding site is located along the coast adjacent to Piltun Bay (Brownell and Chun 1977, Sobolevsky 2000; Weller et al. 2003b; Yazvenko et al. 2002; Blokhin et al. 2003, 2004, Yakovlev and Tyurneva 2003). Another deeper feeding site is located ~30-40km offshore of Chayvo Bay in waters 35-60 m deep (Miyashita et al. 2001, Maminov and Yakovlev 2002, Meier et al. 2002, Yazvenko et al. 2002, Blokhin et al. 2003, 2004) (Fig. 1). However, whales are also observed ranging along the entire northeast Sakhalin coast. Gray whales begin arriving off northeast Sakhalin Island in late May, after sea ice has left the area, and some remain until early December, when sea ice returns.

Photo-id of western gray whales is currently being conducted by two teams of researchers. The US-Russian photo-id team has been working in the Piltun feeding area during 1994-2003 (Würsig et al. 1999, 2000; Weller et al. 2000, 2001, 2003ab). The Far East Branch of the Russian Academy of Sciences (IBM) started working in both the Piltun and Offshore feeding areas during 2002 (Yakovlev and Tyurneva 2003) and 2003. The US-Russian photo-id team deployed a zodiac from shore near the Piltun Bay lighthouse and researchers focused their attentions on areas in the Piltun lagoon area where the whales were found. According to data from these observations, a total of 131 whales had been identified as of late 2003 and the population is estimated to be less than 100 individuals (Weller et al. 2003a, D. Weller pers. comm., May 2004). It is important to note that several of the animals reported by Weller et. al. may have died and the population is thought to remain at approximately 100 animals. This team has documented high levels of annual return and seasonal site-fidelity to the Piltun area for a majority of all known whales (Weller et al. 2003ab). They have also reported that individuals are not always present in the Piltun area, however, this may be explained in part by the recent documentation of the Offshore feeding area in 2001.

Incidental sightings had been reported in this area in the past (Miyashita et al. 2001) and it is very likely that the area has been significantly used by gray whales previous to 2001 but this use was not quantified before 2001 due to minimal survey effort in offshore waters. Gray whale photo-id in the Offshore area in 2000 (Miyashita et al. 2001) and 2002 (Yakovlev and Tyurneva 2003) confirmed that some individuals observed in the Offshore areas have also been observed in the Piltun feeding area and that there is movement of whales between feeding areas within and between years. These results suggest that the whales travel on their feeding grounds most likely in search of preferred prey. The US-Russian photo-id team has reported that nine of ten whales photographed in the Offshore area had been sighted in the Piltun feeding area at some point (D. Weller pers. comm., May 2004).

Major oil industry-funded studies examining western gray whale prey along the northeast coast of Sakhalin Island began in 2001, continued in 2002 and 2003 (Fadeev 2003a,b; Fadeev 2004), and are planned for 2004. The shallow depths (5-15 m) in the Piltun feeding area along Piltun lagoon are characterized by an abundance of potential gray whale food, such as swarming amphipods, isopods, clams, and worms. Predominant prey species where whales were observed feeding in the Piltun area were amphipods, isopods and bivalves and the biomass of benthos at sites where whales were observed feeding averaged 234 g/m^2 and amphipods accounted for 100.4 g/m^2 of this average biomass (Fadeev 2003a,b). Depths greater than 20 m along Piltun Bay are generally characterized by high biomass of sand dollars, however cumaceans are also present in waters >20 m, a species on which eastern gray whales have recently been observed feeding (S. Moore, NMML pers. comm., March 2004). However, to date, western gray whales have not been observed feeding on cumaceans. Studied for the very first time in 2002, the Offshore feeding area was found to be a highly productive area dominated by tube-dwelling benthic ampeliscid amphipods *Ampelisca eschrichti*, comparable in species composition and richness to eastern gray whale feeding areas. This is the first time a highly productive feeding ground with prevalence of *Ampelisca eschrichti* has been documented in the Sea of Okhotsk. *Ampelisca eschrichti* live in dense clusters of tubes which extend 10-15 cm above the bottom surface form a "forest" of tubes – or tube mats. Colonies of *Ampelisca eschrichti* were found mixed with either bivalve mollusks or sea anemones. The average total biomass of the feeding assemblage was 1180±157 g/m^2 and amphipods accounted for about half. The biomass of benthos at sites where whales were observed feeding averaged 1228 g/m^2 and amphipods accounted for approximately half of this biomass (Fadeev 2003a,b). The density and biomass of *Ampelisca* colonies in some cases exceeded the abundance in eastern gray whale ampeliscid feeding areas in the Bering Sea. In both feeding areas, areas rich in food were located in smaller "patches", and whales were found to feed at the patches where a high biomass of prey was located..

Within and between season 'shifts' in the distribution of gray whales in both the Piltun and Offshore feeding areas have been reported by many authors (Johnson 2002; Weller et al. 2003b; Perlov et al. 2003; Blokhin et al. 2003, 2004) and are thought, in part, to be a response to seasonal changes in the distribution and abundance of prey (Weller et al. 2003b; Fadeev 2003a,b, 2004). In addition, higher densities of whales are reported in some parts of feeding areas compared to others. For example, a high density of whales has been generally reported (1) along the southern portion of the Piltun feeding area near the mouth of the lagoon (Weller et al. 2003b, Maminov 2004) where cows-calf pairs are commonly observed (ENL/SEIC unpublished data) and (2) in the northern part of the Piltun feeding area (Blokhin et al. 2003, 2004; Gailey et al. 2004, Maminov 2004). 'Patchiness' of gray whale prey may help explain aggregations and seasonal shifts in the distribution of whales and movements of individual whales within and between the Piltun and Offshore feeding areas (Maminov and Yakovlev 2002).

Seasonal fluctuations in blubber fat reserves in baleen whales is normal after winter periods of fasting and during migration (Perryman and Lynn 2002) and cows can be significantly thinner during years in which they are supporting a calf (Pettis et al. 2004, Weller et al. 2003b). However, photo-id methods can be used to detect changes in body

condition outside of the norm due to disease or starvation (Thompson and Hammond 1992, Pettis et al. 2004). Studies have shown a relationship between reproductive success and body condition (Pettis et al. 2004) and photo-id allows one to look at the relationship between calving success and body condition at individual and population levels. In 1999, the US-Russian photo-id team noted that some of the whales they observed in the Piltun feeding area were noticeably thin (Weller et al. 2000). They defined an abnormally thin whale as having the following features:

- subdermal protrusion of the scapulas with thoracic depressions where the pectoral flippers connect with the body;
- noticeable depressions around the blowholes and head; and
- a pronounced ridge along the dorsal spine of the lumbar and caudal vertebrae resulting in a bulge along the lateral flank.

During photo-id surveys in 1999 (Weller et al. 2000, Burdin et al. 2003), 23.2% of all whales identified (16 of 69) were judged to possess one or more of the above criteria, and during similar surveys in 2000 (Weller et al. 2001, Burdin et al. 2003) nearly half (30 of 58, 51.7%) of the gray whales identified were thin. In 2001, 72 individual whales were identified and 19 adult gray whales out of the 66 adult whales (29% of adults) in the western population were categorized as thin (Weller et al. 2003b, Burdin et al. 2003). The proportion of skinny whales decreased in 2002 to 11.8% of observed individuals (9 of 76) (Burdin et al. 2003) and in 2003, only 12.0% of individual whales (9 of 75) were categorized as "skinny" (D. Weller pers. comm. May 2004). It is notable, however, that some gray whales identified as thin in one year were observed to be recovering the next, and some whales not previously reported to be thin were found to be thin the following year (Weller et al. 2003b). During these years, many mothers with calves were categorized as thin.

In 2002 (September - October) photo-id was conducted by IBM opportunistically in both the Piltun and Offshore feeding areas when the mother vessel, *Nevelskoy,* encountered gray whales and when sea conditions were favorable for photo-id work. Because a number of western gray whale monitoring studies (prey sampling, vessel surveys, acoustic monitoring) were also being conducted from this research vessel, photo-id surveys were non-systematic and occurred when gray whales were encountered during other vessel tasks. The discovery in September 2001 of a new primary offshore whale feeding area (Maminov and Yakovlev 2002) offered IBM researchers the opportunity to study whales in this area in detail for the first time and to determine if there were movements of whales between these two areas. In 2002, photo-id of gray whales was conducted along the entire northeast coast of Sakhalin Island, including both the Piltun and Offshore feeding areas (see Yakovlev and Tyurneva 2003).

The US-Russian photo-id team and our photo-id group are continuing to monitor the number of individuals in the population, determining the number of females with calves, indirectly determining the physiological condition of gray whale individuals and tracking the whales' seasonal and daily movements in both the Piltun and Offshore feeding regions.

METHODS

Study Area

The study area included the entire northeast coast of Sakhalin Island including the Piltun feeding area (N52°40' to N53°30') located along the coast adjacent to Piltun Bay and the Offshore feeding area off Chayvo Bay (N51°50' to N52°25') at depths of 35-60 m. Western gray whales were first documented using this Offshore area in significant numbers during September 2001 (Maminov and Yakovlev 2002, Meier et al. 2002) and were observed to utilize the area again during 2002 (Yakovlev and Tyurneva 2003, Blokhin et al. 2003, Maminov 2003, Weller et al. pers. comm., May 2004) and 2003 (Blokhin et al. 2004, Maminov 2004).

The research vessel *Nevelskoy* was used as a convenient base platform for conducting photo-id and other aspects of the marine mammal research and monitoring program, including vessel-based marine mammal surveys, gray whale prey and acoustic research. Therefore, the *Nevelskoy* traveled to locations along the northeast coast of Sakhalin Island outside the known primary gray whale feeding areas where some gray whales were also observed and photographed.

Field Photo-id

In 2003, opportunistic zodiac-based photo-id of gray whales was conducted on all days when weather allowed safe conditions for use of the zodiac. During poor weather conditions for photographing whales (high wind-driven waves, fog, torrential rain, high seas and poor light), the work was halted due to its extremely low efficiency, the danger of damaging the optical equipment, and potential threats to crew safety. In some of these cases, photo-id was conducted from the mother vessel, the *Nevelskoy*. While the *Nevelskoy* was performing prey sampling and/or acoustic surveys, no photo-id activities were performed from the zodiac regardless of weather conditions due to safety concerns. Photo-id was not conducted from the zodiac if the *Nevelskoy* was at anchor while performing other expedition tasks and could not accompany the zodiac, in accordance with safety protocols.

Visual marine mammal monitoring was conducted during daylight hours and observations were continuous in all types of weather. Information about the location of gray whales recorded from these continuous observations during other vessel research and monitoring tasks allowed the photo-id team to travel directly to gray whale aggregations and reduce search time. This was particularly true of the Offshore feeding area, where the distance between groups of whales or individuals were quite considerable, and the whales' movements were more unpredictable.

When the *Nevelskoy* came to within two kilometers of a group of gray whales in the Offshore area, it slowed to a full stop. The bridge then informed the photo-id team members about the whale sighting and after a safety briefing, the zodiac was launched from the ship. In the Piltun area, the zodiacs were first launched and then used as the

platform to search for whales. Photo-id missions began in conditions permitting safe launching and operation of the zodiac as outlined in the safety regulations. The zodiac used was a 4.8-m long, outboard-powered inflatable zodiac equipped with a digital depth sounder and a Global Positioning System (GPS). The zodiac was also outfitted with all safety equipment, as outlined in a zodiac mission safety plan. The research team consisted of a boat driver, data recorder, digital video camera operator, and digital camera photographer.

Upon initial sighting of a whale, the photo-id zodiac slowed to idle speed and maneuvered to a vantage point approximately 100 m from the whale(s). From that position, observations on whale location (as determined by the GPS), time, behavior, and number of whales in the area, direction of their movement and the presence of killer whales, passing vessels or airplanes and helicopters flying by in the vicinity were recorded. Observations of mud feeding plumes were also recorded both nearby the whales and when whales were not visible. Secondary indicators of whale feeding (such as circling or diving birds in the vicinity or shoaling fish) were also recorded. If whale foraging was observed (as confirmed by feeding plumes or assumed from movements and behavior), the exact GPS position of the whale was recorded and communicated to the *Nevelskoy* via VHF radio. Upon completion of the photo-id mission and only when the zodiac and the whales had vacated the immediate area, the *Nevelskoy* would return to the previously transmitted GPS coordinates to obtain benthic prey samples using a Van Veen grab. All data was recorded on waterproof data sheets as used in 2002 and entered into a notebook computer at the end of each photo-id mission.

The zodiac then moved within 50-100 m of the whale and the individual was photographed. The photo frame and video counter number as related to particular whales was recorded onto data sheets. Water depth (as determined by digital depth sounder), location (as determined by GPS), water temperature (sea surface), salinity, and environmental conditions were recorded for every mission and as they changed throughout each photographic session. Photographs were taken with a Nikon D1X digital camera equipped with a 300-mm fixed F.4 telephoto lens. The use of a high quality digital camera allows rapid data acquisition and reduces the amount of time during the post-season to process and archive images. The photographs were saved with a high resolution and large format setting using JPEG expansion at maximum resolution and 0 compression and the RGB color model. The video camera "accompanied" and provided additional supplementary information. Video footage was recorded on a Canon Optura 20 digital video camera in miniDV fine setting and maximum resolution. Video footage was particularly important to document body condition characteristics (e.g. protruding scapula, depressions behind the blowhole) that are difficult to capture in a still photograph. Contact with a group of whales was maintained until all individuals encountered were photographed or until a predetermined amount of time had passed. After approximately one hour, we terminated the photographic session with a whale to avoid excessive disturbance of the animal, regardless of the number of aspects photographed. The zodiac was then motored away from the group. These procedures were repeated each time additional whale groups were encountered and photographed.

A sighting was defined as either a solitary individual, or two or more whales observed close to one another (within about 10 body lengths of each other), and generally coordinating their diving or direction of movement. Group size estimates were determined from consensus among observers on the zodiac. A "calf" was defined as a first year calf and were identified by their small body size (about one-third that of a mature adult), and demonstrating close association with a particular adult whale (Hamilton and Mayo, Wells and Scott 1990, Weller et al. 2003b).

Images of individual gray whales consist of various aspects of the body, including head, back, dorsal flanks, and flukes. An attempt was made to photograph all aspects of each whale. Whales were photographed sequentially from head to fluke on either the left and right side, and the dorsal and ventral surfaces of their flukes. Priority was given to photographing the right and left sides of each individual, as fluking tendencies vary with individual behavior and foraging depth. Traditionally in gray whale photographic identification, right and left sides then ventral flukes have been used for standard matching procedures (Weller et al. 2002, Calambokidis et al. 2002). Since the likelihood of recapture of an individual (via matching) increases as more information for that individual is amassed into the catalogue, a fourth aspect - dorsal flukes, was added as supplemental information to the matching process. Dorsal flukes of individual whales can often be displayed even in shallow feeding areas, when deeper diving may not be feasible. This technique of adding additional features in an effort to increase accuracy of the matching process, especially during initial years of data collection and catalogue development, has been employed for other marine mammal species with success (Bannister 2000, Glockner-Ferrari and Ferrari 2000, McConkey 1999).

After the photo-id mission was completed, the zodiac returned to the *Nevelskoy.* All digital images were downloaded from the camera's memory card to a laptop computer, backed up to a second external hard drive, and archived onto cds. After verifying that the CD was readable, the data was erased from all of the memory cards in preparation for the next photo-id mission. Information from the datasheets was entered into an Excel database and backed up onto cds. All digital data information was simultaneously stored at three digital locations at all times. All archive data cds were also duplicated with duplicates stored in an offsite location whenever possible.

Photo and Video Analysis

The digital photographs were processed in Adobe Photoshop 7.0 and Adobe Illustrator 10 for subsequent identification and updating of the database. The best photographs for each sighting were printed out on an Epson Photo Stylus 960 color printer onto high quality photo paper and stored in the pre-catalogue binder. Backup copies of digital data were made each day.

Standard photographic matching procedures for pattern-based matching of sides and flukes were followed as described by the International Whaling Commission Special Issue No. 12 (Hammond et al. 1990) This process has since been refined by others working on gray and other large whales (Weller et al. 2003b, Calambokidis et al. 2002). The following aspects of the whale's body were selected to create the catalog (in order of

priority): right (RS) and left (LS) sides of the body, ventral (VF), and dorsal (DF) surfaces of the fluke. For each sighting, the photographs for that sighting and daily mission (zodiac deployment from the mother ship) were reviewed and from all of the photographs of the same animal, the best photos were selected to be placed into the annual precatalog. Each new sighting was compared to previous sightings obtained in that year (2003). If a match was made to an existing photo, it was grouped with other photographs of that individual. After the photographs were matched down to individual separated by aspect, they were compared to whales identified in 2002. If a new whale was found, it was given a new identification number if a quality right or left side photo existed for that individual. Identification numbers were not issued for fluke photos that could not be matched to corresponding right or left sides. All images were then cross compared to all of the 'best' photographs per sighting of the whales found in 2002 and 2003, in order to determine the recurrence of encounters with the same whale and to insure that no duplicate whales occurred in either the previous year's catalogue or the current precatalogue.

A confident match was not made unless the photograph was determined to be of good or excellent quality (poor quality photographs were used for supplemental information only, or digitally archived for potential future use). Side to fluke matches were considered to be reliable when taken in sequential order and if the current photo contained portions of the animal visible in the previous photo. Digital photography greatly assisted with side to fluke matching because of this process. Confident left to right side matches were established by a number of criteria: (1) the whale was photographed as a solitary individual, (2) two sequences were compared with flukes in common for a single sighting, and (3) as a final check to compare matches and assist with right to left matches, whale knuckle height, spacing and ratios were compared (see Calambokidis et al. 1999). This process had to occur three times and be verified by two to three independent matchers before a right to left match was given confidence of 90% or higher and promoted from the pre-catalogue to the final annual catalogue. All whale sighting matches as well as right-left matches and side-fluke matches were verified by two to three independent matching specialists. Whale body pigmentation was the primary feature used to distinguish individuals, with scars and body markings supplementing the matching process. If the annual pre-catalogue matching seemed in order, the whales would be given permanent identification numbers and promoted to the final catalogue. Once the final annual catalogue is completed, any discrepancies between the current annual catalogue and the current catalogue to date will be corrected. Any missing aspects for known whales will be incorporated into the current catalogue and new whales will be added. This process is still ongoing and the merging of the two annual catalogues (2002 and 2003) into one current catalogue has not been completed to date. The available photographs of different aspects of an individual animal were supplemented by photographs of that whale which showed a clear distinguishing mark and could serve as good additional material for field observations. Special attention was given to identifying whales with various deviations from the physiological norm including: (1) thin whales subdivided into four classes of body condition and (2) whales with visible skin sloughing.

Analysis of video footage was not completed upon the writing of this report.

RESULTS

Effort

Photography and videography of whales were done with varying effort from 7 August to 19 September 2003. The efficiency of the photo-id team's work depended heavily on the season's weather conditions. In particular, there were many days of fog during the first half of the expedition. The distribution of time spent by the expedition on the *Nevelskoy* in 2003 was as follows: out of the 69 days of the voyage, 40 were working days; 16 were spent on trips to the work sites and for refueling; and 13 were stormy. The productivity of the survey days depended heavily on the time spent searching for whales. This was especially true of work in the Offshore feeding area.

To calculate effort, we combined the data on photo-id conducted from the zodiac and from the deck of the *Nevelskoy*. The total number of days during which some time was spent on photographing whales was 23 days, including two days when a photographs were taken from the deck of the *Nevelskoy* and from the zodiac on the same day. Characteristics that can be used to assess the efforts involved in photo-id of gray whales off Sakhalin Island in 2003 are reported in Tables 1-5.

Photo-id zodiac-based missions in the Piltun and Offshore feeding areas were similar (Table 2). The number of whale sightings from the *Nevelskoy* approximately corresponded to the number of whale sightings in the Piltun area (80) and in the Offshore area (66) with the use of the zodiac (Tables 3 and 4). However, the number of highly informative photographs with all four photo-id aspects was significantly less than for the surveys from the zodiac. Therefore, photographs taken from the *Nevelskoy* may provide good supplementary data in addition to the basic data obtained by photographing whales from the zodiac. Processing of photos in Photoshop7 allowed us to improve the image quality of about 70% of the photographs to an acceptable quality, by adjusting levels of brightness, and cropping images. They provide satisfactory supplementary material on the whales' daily and seasonal movements in the feeding areas.

The higher photo-id effort and number of photo-id whale encounters in 2003 compared to 2002 is due to: (1) supplemental photos taken from the deck of the *Nevelskoy* in 2003, (2) less expedition time devoted to benthic sampling in control areas in 2003 where whales are unlikely to be encountered, (3) more time devoted to benthic prey sampling where whales are observed feeding, resulting in more time searching for and photographing feeding whales, and (4) expertise gained from the 2002 increased efficiency in 2003. A reprocessing of 2002 photographs is necessary now that the 2003 catalogue is available. Additional photographs of solitary flukes and photos containing body fragments other than standard placement of the dorsal hump central to the photograph, may be matched to previously missing whale aspects thereby increasing whale sighting numbers and decreasing recapture error.

Photo-id Effort from the *Nevelskoy*

Opportunistic photo-id was conducted from the deck of the *Nevelskoy* on eight days (Table 1). From the deck of the *Nevelskoy,* 445 photographs of whales were taken in the

Piltun feeding area and 397 in the Offshore feeding area (Table 2). The average number of frames taken per whale from the deck of the vessel was 12.4 in the Piltun area and 12.8 in the Offshore area.

Photo-id Effort from the Zodiac

During the previous expedition in 2002, 13 days were spent conducting photo-id work, or 22.8% of the total expedition time (Yakovlev and Tyurneva 2003). During the 2002 voyage, from 13 photographic survey days the total photo-id effort (not including travel time to and from the vessel to the first whale position) was 44 hours and 14 minutes (Yakovlev and Tyurneva 2003). According to the data from 2002 field observations, 93 whale sightings were recorded from the zodiac.

In 2003, photo-id work was conducted from the zodiac on 17 days, which was 24.6% of the total expedition time. The total time spent directly on the photo-id was 42.6 hours – 17.2 hours for the Piltun area (7 days) and 25.4 hours for the Offshore area (10 days). According to only partially analyzed data, 3,034 photographs of whales were taken from the zodiac during the 2003 expedition in the Piltun area and 3,137 photos in the Offshore area (Table 5). During photo-id missions in 2003, 86 sightings totaling 146 unidentified whales (including repeat encounters with individuals) were encountered from the zodiac. An average of 39.7 frames were taken per whale that was encountered in the Piltun area and 47.5 in the Offshore area (Tables 2 and 5).

In the Piltun area, whales were photographed on 7 days in 2003 (4 days in 2002), consisting of 14 missions (8 missions in 2002). During this time, 80 whales (unidentified) were photographed (possibly including repeat encounters with some individual whales). The average number of whales encountered in this area per day was 11.4. In 2002, there were 21 such encounters, and the average number of whales per day was 5.25.

In the Offshore area, whales were photographed on 10 days from the zodiac (9 days in 2002), consisting of 21 missions (17 missions in 2002). The average number of whales photographed in this area per survey day was 6.6. In 2002, 8.0 whales were photographed per day.

Taking photos of all four aspects proved to be extremely important not only for creating the precatalog of whales that we photographed for the first time in 2003, but also for updating photographs of whales with aspects that had not been completely photographed in 2002. In 2003, 39 individual whales were completely photographed (all four aspects (Table 6). Eleven whales were photographed on three sides; 23 whales were photographed for two aspects; and eight whales were only photographed for one aspect. Calves rarely showed their flukes and therefore, only sides were photographed. In 2002, all four aspects were documented for 17 individuals; three aspects were photographed for 3 individuals; two aspects were photographed for 9 individuals; and only one aspect was photographed for 17 individuals (Yakovlev and Tyurneva 2003). Comparison of the 2002 and 2003 seasons indicate that the more aspects per whales were documented in 2003 than in 2002, most likely as a result of increased experience on part of the zodiac driver and the photographer and the use of the digital camera, as well as partially do the unequal

effort between the Offshore and Piltun regions and the behavioral differences of foraging whales in deeper waters. Whales in the Offshore area, were not cow/calf pairs, and were located in deeper waters and therefore showed flukes more regularly, with deeper and regular diving patterns than whales identified inshore in Piltun.

Group size and Distribution

Mean group size for 122 groups observed in 2003 was 2.03 with a range of 1-5 whales per group. Solitary gray whales accounted for 48.3% of all whales that were observed off the northeast coast of Sakhalin (this figure may include repeat encounters and errors in determining the true number of them, due to relatively brief observations). Groups of two individuals accounted for 31.6%; groups of three - 15%; four - 3.3%; and groups of five whales - 1.6% (Table 7).

There were differences in group size between the Offshore and Piltun feeding areas. The percentage of solitary whales in the Offshore area was 56.89%, while in the Piltun area it was 40.32%. Groups of two whales accounted for 22.41% in the offshore area and 40.32% in the Piltun area. Groups of three whales accounted to 17.24 % and 12.9%, in the Offshore and Piltun areas, respectively. The percentage of whales in groups of four was the same in the two areas. Two sightings of five whales were discovered only in the Piltun area (see Table 7).

The average depth in the Piltun area where whales were photographed was 14.1 m (range 6 - 30.4 m), while in the Offshore area it was 52.3 m (range 44.1 – 64.2m). Water temperatures in both areas were similar (see Table 5). In the Piltun feeding area, most sightings were within 5 km of shore (range 0.2 – 7.5 km). In the Offshore area, whales ranged between 12-50 km from shore and whales were observed further east than in previous years (see Maminov 2004). This may in part be explained by minimal survey effort over the 50 m contour line in 2001 and 2002 compared to 2003.

Individual Recognition and Sighting Patterns

From 7 August to 19 September 2003 (23 working photo-id days), there were 214 encounters with gray whales. Analysis resulted in the documentation of 154 sightings of 81 individual whales (Table 8). In the Piltun and Offshore feeding areas, 50 and 35 individual whales were observed, respectively (Table 9). Four individual whales were observed in both the Piltun and Offshore feeding areas. In total, in 2002 and 2003, 96 individual whales have been identified.

To date, 17 individual whales have been identified from the images collected from photo-id from the *Nevelskoy*, which have not yet been completely processed and six whales were new in 2003 (id numbers RGW049, RGW067, RGW072, RGW075, RGW076 and RGW086).

Resighting, Site Fidelity and Association Patterns

It is interesting to track the frequency of encountering identified individual whales over time within and between the 2002 and 2003 seasons (Table 8 and 10). In 2002, there were 66 sightings consisting of 47 photo-identified whales. In 2003, there were 154 such sightings of 81 individual whales. The average number of sightings per identified whale was 1.40 in the 2002 and 1.90 in 2003 (Tables 8 and 9). The monthly presence of absence of whales in 2002 and 2003 in shown in Table 10.

The frequency of encountering identified whales during the whole photo survey period in 2003 was as follows (see Table 8): 36 whales were encountered once; 23 whales, twice; 16, three times; and 6 whales were encountered four times. In 2002, 29 whales were encountered once; 14, twice; and 3 whales were encountered three times.

In 2003, we were able to track the route of whale RGW002 for one day on 5 September in the Offshore feeding area from 10:50 AM until 5:13 PM. Over the course of a day, this whale traveled ~20 km over an area ~50km^2. The observation of this animal serves as a good illustration supporting Bogoslovskaya's statement (1966) about the temporary nature of groups of gray whales. On 27 August 2003, whale RGW002 was feeding together with whale RGW012. The following day, whale RGW002 was feeding alongside whale RGW088. On the morning of 5 September, RGW002 was observed with whales RGW013 and RGW035, and RGW020 but by the afternoon, was observed alone. On 8 September, RGW002 was observed again with whale RGW035, and was joined by whale RGW040, which had been observed in the Piltun area 10 days earlier. Whale RGW020, which had been swimming together with whale RGW002 on 5 September was observed alone nearby.

As we can see from the examples given, repeat encounters with whales and photographic recording of them over the course of a day, as well as encounters with the same whales over the course of a season, provide very important data on how fast the whales move in their feeding areas and the dynamics of their visits to these areas.

Cow-Calf Pairs

In addition to monitoring the size of this population, it is very important to continue to monitor the number of females with calves and indirectly document health status through indicators such as body weight and skin condition. Photo-id conducted by the US/Russian photo-id team has indicated that fewer than 50 reproductive adult individuals have been documented along the northeast coast of Sakhalin Island, 14 of which are reproductive females (D. Weller pers. comm., May 2004).

In 2003, we identified ten cow-calf pairs (Table 11) (two more calves still need to be precisely identified from the video data). Cow-calf pairs were only observed in the Piltun area. On 25 August, a group of three calves with one adult female (RGW041) was observed. On 18 September, a group of four calves without any adults present was observed. On 19 September, the female RGW041 was encountered alone without a calf. This agrees with Weller et al. (2000) that the calves make the transition to swimming on their own in July-September. According to Bogoslovskaya's data (1996) for the gray

whales in waters of the Chukchi Peninsula, age differentiation of the groups begins in July-August, when the calves leave their mothers and gather together in the shallowest waters rich in food.

Exchange between Piltun and Offshore feeding areas

The discovery of a primary feeding area offshore of Chayvo Bay in 2001 (Maminov and Yakovlev 2002) gave us the opportunity to determine the nature of the animals' movements between the Piltun area and the newly documented Offshore area.

The frequency of encounters with identified individual whales during the entire survey period is important in determining how much exchange of whales there is between these two areas. In 2003, 85 sightings of 51 identified individuals were observed in the Piltun area and 69 sightings of 34 identified individuals in the Offshore area (see Table 9) and only four individual whales were observed in both the Piltun and the Offshore areas (see Tables 9 and 10).

One whale (RGW040) was observed in the Piltun area on 24-25 August and was then observed in the Offshore area on 8 September. Another whale (RGW045) was observed in the Piltun area on 23 and 25 August and in the Offshore area on 5 and 8 September. A third individual (RGW062) was observed in the Piltun area on 3-4 September and in the Offshore area on 13 September. It is interesting that on 15 August whale RGW037 was encountered in the Piltun area, was observed again on 7 September in the Offshore area, and 12 days later was once again observed in the Piltun area. According to our data from 2002, only one whale, RGW026, was documented in both the Piltun and Offshore feeding areas in the same season.

Of the 32 whales that were individually recognized during both 2002 and 2003, 10 individuals were observed in both areas. The majority of these individuals were recorded in 2002 in the Offshore area and in 2003 in the Piltun area. The whales observed in the Offshore area in 2002 were primarily females without calves and were observed with calves in the Piltun area in 2003. Movements between feeding areas and habitat use of females with calves will be more fully understood and more fully substantiated statistically only when data is accumulated after additional surveys in 2004.

It is important to note that our team spent limited time in the Piltun feeding area for parts of two feeding seasons in 2002 and 2003 (see Table 5). As additional data are collected, it is likely that a significantly higher percentage of the whales observed in the Offshore area will have been sighted at some time in the Piltun area and vice versa. D. Weller has reported that up to 2003, 9 of 10 whales photographed in the Offshore area had been sighted in the Piltun feeding area at an earlier time (D. Weller pers. comm., May 2004).

Physical Condition

Body weight

In 2003, during data processing, several whales appeared visibly thinner than expected after winter. A hierarchal system of categorizing the levels of emaciation of the whales was developed based upon the original methods outlined by Weller et al. (2001) from slightly thin whales of the Class 1 to Class 3 (Table 11). The video data, which are the most acceptable data format for making this determination, have not yet been completely processed, but has only been reviewed to date to supplement the photo-id matching and analysis process. Photographic examples of each of the classes and a "Body Condition Key" is under development and will be available for 2004. A whale was defined to be undernourished if one or more of the four following criteria were observed (adapted from Weller et al. 2003a):

- an obvious subdermal protrusion of the scapulas from the body with associated thoracic depressions at the posterior and anterior insertion points of the pectoral flipper
- the presence of noticeable depressions or concavities around the blowholes and head with a post-cranial 'hump' along the dorsal surface
- a pronounced ridge along the neural/dorsal spine of the lumbar and caudal vertebrae resulting in the appearance of a bell-shaped body and 'bulge' along the lateral flank
- presence or protruding ribs and vertebrae along the dorsal surface and/or lateral flanks or ribcage

If any one or more of the above criteria were observed and noted in photographs or video data, the subject animal was categorized based upon body condition for that sighting. The final categorization given to a subject animal is the highest Class number associated with that animal for any given field season. The body condition classes are defined as follows:

Class 0: whale shows no cases of any of the four above criteria
Class I: whale shows a mild case of any one of the four criteria
Class II: whale shows a moderate case of any of the four criteria
Class III: whale shows an extreme case of any of the four criteria

The subjective terminology of mild, moderate, and extreme were agreed upon as a group by the photo-id team and advisors, with specific photographic or videographic examples for use as a "key". Photographic illustrations of each of these cases will be prepared (when photos are available) for subsequent reports. In all, 21 undernourished whales were observed.

The fewest thin whales were found in the Offshore feeding area. Out of 11 whales, six were categorized as Class I, four were categorized as Class II, and one was Class III. In the Piltun area, 11 whales observed with one or more of the defined criteria were

observed. One was classified as Class I, eight of them were defined as Class II; and two Class III (Tables 10 and 11). One whale classified as Class I was observed in both the Piltun and Offshore areas in 2003. It is noteworthy that the most pronounced emaciation was for females with calves. Of the 11 whales observed in the Piltun area with signs of the above criteria, eight were females with calves. The sex of the other three whales is unknown.

When we calculated the percentage of thin whales in relation to the number of animals observed, Class I was disregarded, since it is insignificant in its manifestation. So, the percentage of thin whales (Class II or greater) was 18.52% of the total number of whales assessed in 2003 (15 out of 81). Class I whales were usually considered either to be in recovery (if the individual was classified as undernourished in previous years), poor photographic examples, or to be within the normal range variation in body weight for migratory and seasonally foraging populations. No calves were observed possessing any of the criteria defining a thin whale and were categorized as Class 0.

Skin Sloughing

During processing of the photo-id data from 2003, cases of skin disorders were observed on nine whales, which were not observed in 2002 (see Table 11). Except for one animal, all of the whales with observed skin problems were observed in the Piltun area with various degrees of epidermal sloughing. Whales RGW029 and RGW059 were encountered over the course of several days. In these cases, skin sloughing appeared to begin from the backbone. In one day, from 24 to 25 August, skin sloughing progressed rapidly on whale RGW029. A few days later, the whale was observed with no sloughing skin. This same pattern was observed with whale RGW059. This molting or shedding process seemed to progress in stages starting at the backbone (m1) progressing down the body toward the ventral surface or belly (m2) until all dead or damaged skin was sloughed and the whale was observed with no evidence of sloughing (m3). Four whales with observed skin sloughing were categorized as “skinny” (≥ Class II) and were cows with calves.

DISCUSSION

Preliminary results of photo-id effort conducted in 2002 and 2003 along the northeast coast of Sakhalin Island in the primary gray whale feeding areas identified a total of 96 individual gray whales. Combination of the two years of work into one current catalogue, and establishing a protocol for least population count such as only counting right or left sides of individuals (Darling 1984, Weller et al. 2001, Weller et al. 2003b) will provide better confidence in least-count estimates for population size. Naturally, the number of encounters with whales that have already been photo-identified will rise with each new season, as will the confidence and ease of the entire matching process. Newly obtained data on the same whales are very valuable for determining their return to feeding places, distribution, physiological condition and recording changes in their photo-id characteristics during the year.

Photo-id analysis from 2002 and 2003 showed that gray whales move within and between the Piltun and Offshore areas both within and between years. As was shown above,

information about the whales' movement between areas over the course of a single season is only provided by repeat encounters with individually recognized whales in the same season. A single encounter with a gray whale in one area in a season and a subsequent photo-recording of it (even just one) in the other area in the next year also indicates exchange between the feeding areas (see Table 10). Therefore, the absence of individuals in the Piltun feeding areas as reported by Weller et al. (2003b) may be a result of individual whales spending more time in the Offshore feeding area. The absence of whales in the Piltun and Offshore feeding areas may also be explained by whales ranging outside of these primary feeding areas. Recent observations of feeding gray whales south of Piltun Bay near Lunsky Bay (SEIC unpublished data) and recognition of individual whales at other locations in the Sea of Okhotsk (Weller et al. 2002) suggest that the annual range of individual gray whales requires further study.

Seasonal variability in the distribution of cetaceans has been extensively reported and is thought to be a response to seasonal habitat fluctuations and movements of prey (Payne et al. 1986, Piatt et al. 1989, Payne et al. 1990, Kenney et al. 1995, Weinrich et al.1997, Wilson et al. 1997, Forney and Barlow 1998, Karczmarski et al.1999). Eastern gray whales feeding along the west coast of Vancouver Island, Canada, rotate feeding sites and prey types within and between summer feeding seasons as a function of the distribution and abundance of their prey (Bass 2000; Dunham and Duffus 2001, 2002; Meier 2003, Kopach 2004). The distribution of feeding eastern gray whales along the west coast of North America is variable within and between years with whales utilizing areas from northern California to southeast Alaska from spring to fall involving significant interchange of individuals between areas with variable use of habitat within and between years (see Calambokidas et al. 2002). Recent research has indicated that eastern gray whales are dynamic and selective foragers that can use various types of prey and foraging tactics rapidly to take advantage of short-term availability of energy and are not exclusively benthic foragers (Dunham and Duffus 2001, 2002; Moore et al. 2003). Eastern gray whales are multi-scale animals that can show site-fidelity at a regional scale (e.g. northeast Sakhalin Island) but range over a larger area to use smaller sites or "nodes" within the region as a function of the distribution and abundance of prey over time. In addition to responding to the distribution and abundance of prey, there is some evidence that eastern gray whales and other apex predators can significantly influence the distribution and abundance of their prey through foraging (Bowen 1997, Meier 2003). These "top-down" effects can alter a prey community to the extent that whales will abandon it for months or years while it recovers to a richness than can be utilized again, influencing the seasonal distribution of the whales. Although western gray whales are genetically isolated from eastern gray whales, it is likely that the manner in which eastern and western gray whales make foraging decisions in response to the distribution and abundance of prey in different ecological contexts is similar.

Without a doubt, the Offshore region is a more difficult area in which to conduct photo-id. One of the possible reasons for this is the greater water depths in this area, therefore whales are diving longer and the locations where they surface are more unpredictable and farther from the zodiac than in the Piltun area. The area is not sheltered by proximity to land or shallows, and therefore is subject to more pronounced wind and wave effects, conditions that make photo-id difficult. In addition, due to the larger size of the Offshore

area, it is more difficult to find aggregations of whales or solitary individuals from the mother ship *Nevelskoy*. The large size of this area means that the observers may be unaware that the whales have moved into an area that has already been surveyed, and this time was wasted trying to find whales.

The continued observation of abnormally undernourished whales remains unexplained (also see Weller et al. 2003b). The causes of emaciation in both North Pacific populations of gray whales are not clear, but several lines of evidence suggest that over-exploitation of the available food supply and/or a possible large scale climatic/oceanographic regime shift affecting productivity in the North Pacific region have been at least partially responsible. As the population of eastern gray whales increases to levels estimated to be above those before the period of American whaling intraspecific competition pressures in the subarctic feeding grounds may be increasing (LeBoeuf et al. 2000, Moore et al. 2001, 2003). Other authors have suggested that changes in the extent and concentration of sea ice in the Arctic Ocean due to global warming over the past twenty to thirty years may alter seasonal distributions, geographic ranges, patterns of migration, nutritional status, or reproductive status (Tynan and DeMaster 1997, Perryman et al. 2002) potentially resulting in increased use of subarctic areas. Grebmeier and Barry (1991) suggest that due to global warming, primary production in surface waters may be depressed resulting in a reduced availability of benthic prey. LeBoeuf et al. (2000) suggested that reduced availability of prey caused by a decline in productivity in the North Pacific may be limiting gray whale feeding in subartic areas. It is conceivable that these large-scale climatic/oceanographic events may have affected the entire North Pacific region and thus may have had simultaneous and similar impacts on both the western and the eastern gray whale populations (see Brownell and Weller 2001). However, recent gray whale prey studies have identified the Piltun area, and particularly the Offshore feeding area, as very rich prey sources (Fadeev 2003a,b, 2004) and it unlikely that food is limiting, however this requires further study. It is also conceivable that some other factor(s), such as disease or anthropogenic impacts during winter, migration, and/or the summer feeding period, may have simultaneously and similarly affected one or both gray whale populations. Interestingly, some whales that showed signs of emaciation in 2002 did not show such signs this year and Weller et al. (2003b) has reported similar seasonal recovery.

In addition to unexplained thin individual whales, skin sloughing was observed in some animals in 2003. This phenomenon remains unexplained, but may be a result of several factors including diseases caused by bacteria, viruses, fungi (Gaydos et al. 2004), internal and external parasites, pollution, or excessive exposure to freshwater. Cetacean poxviruses can cause skin lesion ‘tatoos’ or ‘rings’ (Van Bressem et al. 1999) and it has been suggested that poxvirus infection could cause neonatal and calf mortality in affected individuals (Van Bressem et al. 1999). Skin lesions in bottlenose dolphins caused by poxvirus were observed to become raised and blanched, then disappeared with sloughing skin (Smith et al. 1983). Skin lesions have also been observed in dolphins living in cold, low saline waters (Thompson 1999). In 1987 and 1988, several hundred bottlenose dolphins washed up dead along the US coast with lesions and severe skin sloughing and an investigation by NOAA determined that these dolphins had been poisoned by a naturally occurring red tide toxin. Health effects from red tide toxins have also been reported in other marine mammals (Dhermain et al. 2002, Durbin et al. 2002). Organic

pollutants have been implicated in the high incidence of tumours and skin lesions in marine mammals by disrupting hormones in the body (Béland et al. 1992). Similar skin peeling has been reported in blue whales (Sears et al. 2000) and right whales (Pettis et al. 2004), but is previously unreported in the eastern or western gray whale populations. It is important to note that only skin sloughing was observed and skin lesions were not observed.

Our preliminary observations suggest that this skin sloughing is very reminiscent of natural annual molting. The white whale (beluga) is the only whale species that molts annually (Boily 1995). Beluga whales go through an annual molting, which takes place when the temperature and salinity of the water change. The examples of skin sloughing that we documented showed that the skin recovers relatively quickly after sloughing, and no subsequent pathological consequences are observed on the surface of the whale's skin. This phenomenon requires further study to understand the duration and meaning of skin sloughing events. It is especially important to document whale skin sloughing in 2004 in whales that were found with skin sloughing in 2003. It is also important to note that known animals in 2002 that were observed sloughing in 2003 had not shown any peeling of skin in the 2002 photographs. Further photography of the whales' skin, as well as direct skin samples from the affected areas for histological study and analysis could be collected to determine the presence of pathogenic viruses, microbes or fungi.

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FIGURES

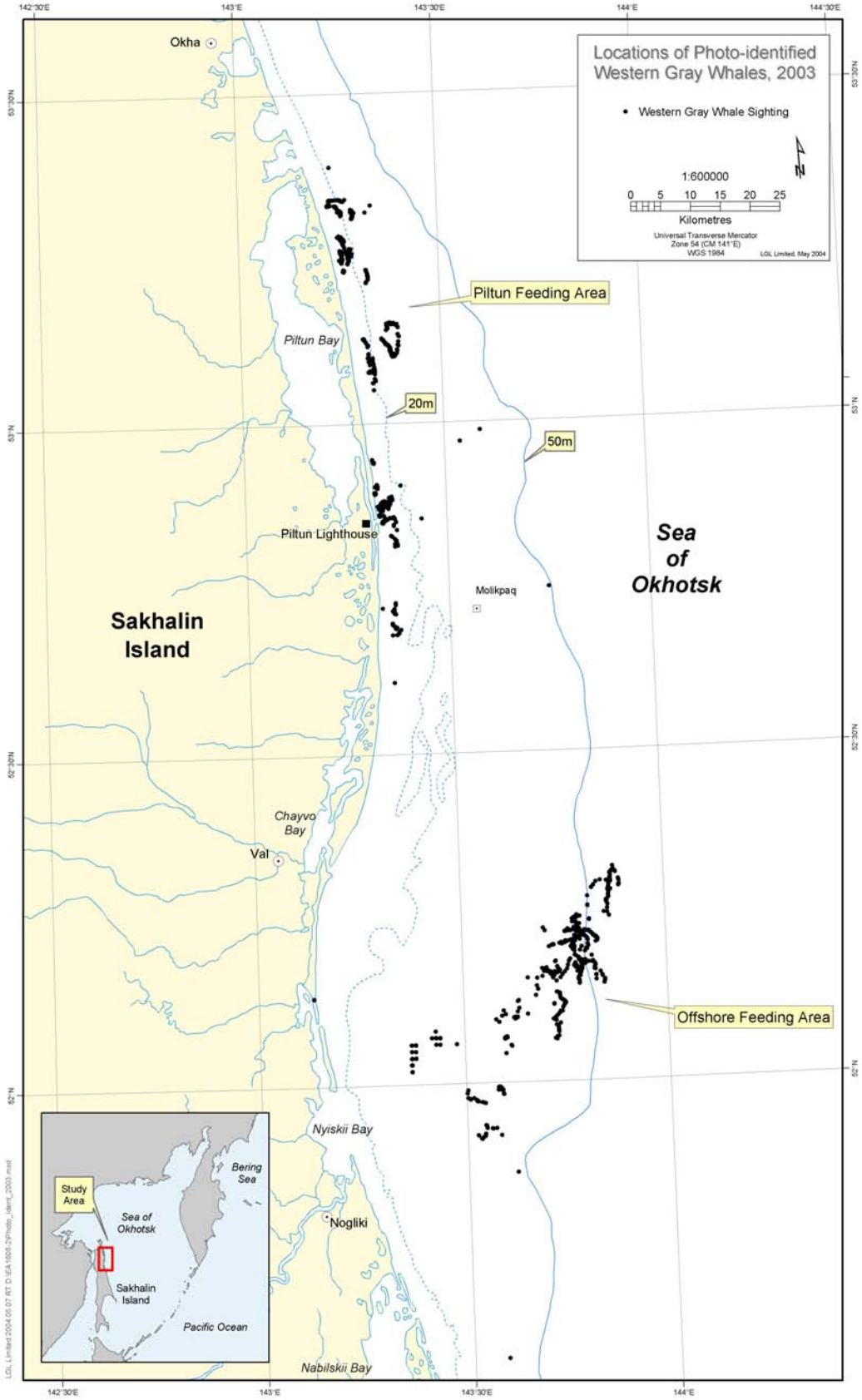

Figure 1. Locations of photo-identified gray whales along the northeast coast of Sakhalin Island, 2003.

TABLES

Table 1. Opportunistic photo-id of gray whales from the deck of the vessel *Nevelskoy* off northeastern Sakhalin Island, 2003.

Date	Area		Sighting	Number	Number of	Sighting duration
	Piltun	Offshore	number	of whales	frames	min.
8/9/2003	x		1	1	3	5
8/13/2003	x		1	2	6	4
	x		2	3	7	4
	x		3	2	3	4
	x		4	1	7	8
	x		5	2	9	6
	x		6	1	7	5
8/14/2003		x	1	1	9	6
8/15/2003	x		1	2	8	5
	x		2	2	13	9
	x		3	2	3	4
	x		4	1	14	6
	x		5	1	18	5
	x		6	2	11	5
	x		7	5	41	9
8/18/2003		x	1	2	30	4
		x	2	1	36	9
		x	3	2	27	16
		x	4	1	2	4
		x	5	1	4	3
		x	6	3	8	15
		x	7	1	2	1
		x	8	1	6	4
		x	9	1	3	2
8/23/2003	x		1	3	87	19
	x		2	3	94	21
8/25/2003	x		1	3	114	25
9/8/2003		x	1	1	6	2
		x	2	1	5	6
		x	3	3	26	3
		x	4	2	57	11
		x	5	2	35	6
		x	6	3	31	3
		x	7	3	69	18
		x	8	1	26	4
		x	9	1	15	2
8	17	19	36	67	842	263
days	sightings	sightings	sightings	whales	frames	min.

Table 2. Descriptive statistics from opportunistic gray whale photo-id from the deck of the *Nevelskoy* off northeastern Sakhalin Island, 2003.

No.	Parameters	Piltun Area	Offshore Area	Total for Both Areas
1	Number of survey days	5.0	3.0	8.0
3	Number of sightings	17.0	19.0	36.0
4	Total number of whales sighted (field data)	36.0	31.0	67.0
6	Average number of whales per survey day	7.2	10.3	8.4
7	Average number of whales per sighting	2.1	1.6	1.9
9	Total duration of sightings, min.	144.0	119.0	263.0
12	Number of frames	445.0	397.0	842.0
13	Average number of frames per survey day	89.0	132.3	105.3
15	Average number of frames per sighting	26.2	20.9	23.4
16	Average number of frames per whale	12.4	12.8	12.6

Table 3. Descriptive statistics from gray whale photo-id conducted from a zodiac in the Piltun feeding area, northeast Sakhalin Island, 2003.

Date	Mission	Sighting	Number	Duration, (min.)			Number of	Depth,	Temperature (°C)	
	number	number	of whales	Mission	Sighting	Trip	frames	(m)	air	water
8/24/2003	1	1	1	72	23	49	652	25.5	15.5	12.9
	2	1	2	55	33	22		17.0	19.5	13.4
	3	1	1	327	53	98		16.7	23.7	14.0
	3	2	2		59			16.0	23.7	14.0
	3	3	2		68			16.0	23.7	14.0
	3	4	2		49			27.0	23.7	14.0
8/25/2003	1	1	2	180	10	91	566	6.0	12.0	10.0
	1	2	2		10			5.8	12.0	10.0
	1	3	2		5			9.9	12.0	10.0
	1	4	1		8			6.0	12.0	10.0
	1	5	2		13			7.0	12.0	10.0
	1	6	4		23			9.0	12.0	10.0
	1	7	2		8			9.0	12.0	10.0
	1	8	3		12			8.8	12.0	10.0
	2	0	0	152	0	152			20.0	14.0
	3	1	1	94	6	41		19.0	21.1	13.5
	3	2	3		19			19.0	21.1	13.5
	3	3	1		2			19.0	21.1	13.5
	3	4	2		20			19.0	21.1	13.5
	3	5	1		6			13.5	21.1	13.5
9/2/2003	1	1	1	113	28	33	195	12.0	20.0	10.5
	1	2	1		52			30.4	20.0	10.5
9/3/2003	1	1	4	195	67	97	715	10.2	15.8	10.0
	1	2	2		31			18.3	15.8	10.0
	2	1	5	127	25	60		8.2	14.0	10.3
	2	2	1		12			11.0	14.0	10.3
	2	3	2		23			12.4	14.0	10.3
	2	4	2		2			12.0	14.0	10.3
	2	5	1		5			12.0	14.0	10.3
9/4/2003	1	1	2	162	11	73	311	12.0	13.0	11.8
	1	2	2		37			12.0	13.0	11.8
	1	3	3		26			12.0	13.0	11.8
	1	4	2		15			14.0	13.0	11.8
9/18/2003	1	0	0	80	0	80	487		14.1	8.6
	2	1	1	110	18	33		18.3	13.2	10.8
	2	2	1		29			13.7	13.2	10.8
	2	3	1		5			11.7	13.2	10.8
	2	4	1		25			14.0	13.2	10.8
	3	1	2	135	27	13		17.5	13.2	10.8
	3	2	1		69			16.2	13.2	10.8
	3	3	3		9			16.0	13.2	10.8
	3	4	2		17			10.6	13.2	10.8
9/19/2003	1	1	1	135	4	61	108	13.9	14.1	8.9
	1	2	1		5			14.0	14.1	8.9
	1	3	1		24			15.0	14.1	8.9
	1	4	1		41			14.9	14.1	8.9
7	14	46	80	1937	1034	903	3034	14.1	15.7	11.2
days	missions	sightings	whales	min.	min.	min.	frames	m	degrees	degrees

Table 4. Descriptive statistics from gray whale photo-id conducted from a zodiac in the Offshore feeding area, northeast Sakhalin Island, 2003.

Date	Mission	Sighting	Number	Duration, (min.)			Number of	Depth,	Temperature (°C)	
	number	number	of whales	Mission	Sighting	Trip	frames	(m)	air	water
8/7/2003	1	1	2	83	32	31	412	51.7	16.0	8.4
	1	2	1		20			52.3	16.0	8.4
	2	1	3	142	44	72		48.0	18.2	
	2	2	3		26					
8/27/2003	1	1	1	167	74	39	412	51.1	13.0	11.0
	1	2	1		54			55.0	13.0	11.0
	2	1	2	170	45	87		58.5	13.0	10.5
	2	2	2		14			56.0	13.0	10.5
	2	3	1		24			50.0	13.0	10.5
8/28/2003	1	1	2	185	54	126	450	44.1	13.1	11.3
	1	2	1		3			44.1	13.3	11.3
	1	3	1		2			46.0	13.3	11.3
	2	1	4	250	136	114		47.1	20.4	12.3
	3	1	1	105	24	73		50.0	19.7	10.0
	3	2	3		8			56.0	19.7	10.0
9/5/2003	1	1	4	72	55	17	727	52.8	16.9	10.9
	2	1	2	157	10	70		54.2	14.1	11.0
	2	2	1		8			55.0	14.1	11.0
	2	3	2		69			53.3	14.1	11.0
	3	1	1	154	9	60		56.7	19.8	11.0
	3	2	1		14			54.0	19.8	11.0
	3	3	1		71			56.0	19.8	11.0
9/6/2003	1	1	1	148	105	43	58	46.6	17.1	12.4
	2	1	1	50	22	28		46.0	12.8	11.9
9/7/2003	1	1	1	110	13	37	281	56.8	15.8	10.5
	1	2	3		60			54.7	15.8	10.5
	2	1	1	173	33	67		54.2	19.3	11.1
	2	2	2		73			60.5	19.3	11.1
	3	0	0	77	0	77		n.d.	19.6	11.2
9/8/2003	1	1	1	325	31	244	125	54.8	17.4	11.8
	1	2	1		20			64.2	17.4	11.8
	1	3	1		30			60.7	17.4	11.8
9/9/2003	1	1	1	85	37	48	18	49.2	18.0	12.0
9/10/2003	1	1	2	177	78	78	313	53.7	16.7	12.0
	1	2	1		21			52.8	16.7	12.0
9/13/2003	1	1	3	150	52	50	341	47.7	15.5	10.4
	1	2	1		48			46.3	15.5	10.4
	2	1	2	112	76	36		49.8	15.1	11.1
	3	1	3	110	14	81		49.6	15.2	10.5
	3	2	1		15			47.0	15.2	10.5
10	21	40	66	3002	1524	1478	3137	52.3	16.2	10.9
days	missions	sightings	whales	min.	min.	min.	frames	m	degrees	degrees

Table 5. Descriptive statistics from gray whale photo-id conducted from a zodiac off northeastern Sakhalin Island, 2003.

No.	Parameters	Piltun Area	Offshore Area	Total for Both Areas
1	Number of survey days	7	10	17
2	Average depth, m	14.1	52.3	33.2
3	Average air temperature, °C	15.7	16.2	15.9
4	Average water temperature, °C	11.2	10.9	11
5	Number of missions	14	21	35
6	Number of sightings	46	40	86
7	Total number of whales sighted (field data)	80	66	146
8	Average number of whales per survey day	11.4	6.6	8.6
9	Average number of whales per mission	5.7	3.1	4.2
10	Average number of whales per sighting	1.7	1.6	1.7
11	Total duration of missions, min.	1937	3002	4939
12	Total duration of sightings, min.	1034	1524	2558
13	Transit time to survey area, min.	903	1478	2381
14	Number of frames per voyage	3034	3137	6171
15	Average number of frames per survey day	433.4	313.7	363.0
16	Average number of frames per mission	216.7	149.4	176.3
17	Average number of frames per sighting	65.9	78.4	71.7
18	Average number of frames per whale (field data)	37.9	47.5	42.3

Table 6. Number of aspects photographed for individual gray whales off the northeast coast of northeast Sakhalin Island, 2003.

Whale number	Right Side	Left Side	Dorsal Fluke	Ventral Fluke	Number of aspects	ID Efficiency 100%
RGW002	y	y	y	y	4	y
RGW004	y	y	y	y	4	y
RGW005	y	y	y	y	4	y
RGW006	y	y	y	y	4	y
RGW007	n	n	y	y	2	n
RGW008	y	y	y	y	4	y
RGW012	y	y	y	y	4	y
RGW014	y	y	y	y	4	y
RGW015	y	y	y	y	4	y
RGW016	y	y	y	y	4	y
RGW017	y	y	y	y	4	y
RGW019	n	y	n	n	1	n
RGW020	y	y	y	y	4	y
RGW021	y	y	y	n	3	y
RGW022	y	y	y	y	4	y
RGW026	y	y	y	y	4	y
RGW027	y	y	n	n	2	y
RGW028	y	y	y	y	4	y
RGW029	y	y	y	y	4	y
RGW030	y	y	n	n	2	y
RGW032	y	y	y	y	4	y
RGW034	y	y	y	n	3	y
RGW035	y	y	y	y	4	y
RGW037	y	y	y	y	4	y
RGW038	y	y	y	y	4	y
RGW039	y	y	n	n	2	y
RGW040	y	y	y	y	4	y
RGW041	y	y	n	y	3	y
RGW042	y	y	y	y	4	y
RGW045	y	y	y	y	4	y
RGW046	y	y	y	y	4	y
RGW047	n	y	n	n	1	n
RGW048	y	y	y	y	4	y
RGW049	y	y	y	y	4	y
RGW050	y	y	n	n	2	y
RGW051	y	y	y	y	4	y
RGW052	y	y	y	y	4	y
RGW053	y	y	y	y	4	y
RGW054	y	y	n	n	2	y
RGW055	y	y	y	y	4	y
RGW056	y	y	y	n	3	y
RGW057	y	y	y	y	4	y
RGW058	y	y	y	y	4	y
RGW059	y	y	y	y	4	y
RGW060	y	y	y	y	4	y
RGW061	y	y	y	y	4	y
RGW062	y	y	n	n	2	y
RGW063	y	y	y	y	3	y

Whale number	Right Side	Left Side	Dorsal Fluke	Ventral Fluke	Number of aspects	ID Efficiency 100%
RGW064	y	y	y	y	4	y
RGW065	y	y	n	n	2	y
RGW066	y	y	n	n	2	y
RGW067	y	y	y	n	3	y
RGW068	y	y	n	n	2	y
RGW069	y	y	y	y	4	y
RGW070	y	y	n	n	2	y
RGW071	y	y	y	y	4	y
RGW072	n	y	y	y	3	y
RGW073	y	y	n	n	2	y
RGW074	y	y	y	n	3	y
RGW075	y	n	y	y	3	y
RGW076	y	y	n	n	2	y
RGW077	y	y	n	n	2	y
RGW078	y	y	y	n	3	y
RGW079	y	y	n	n	2	y
RGW080	y	y	n	n	2	y
RGW081	y	y	n	n	2	y
RGW082	y	y	n	n	2	y
RGW083	y	y	n	n	2	y
RGW084	y	y	y	y	4	y
RGW085	y	y	n	n	2	y
RGW086	y	y	n	n	2	y
RGW087	y	y	n	n	2	y
RGW088	y	y	y	y	4	y
RGW089	y	n	n	n	1	n
RGW090	y	y	n	n	2	y
RGW091	n	y	n	n	1	n
RGW092	y	n	y	y	3	y
RGW093	y	n	n	n	1	n
RGW094	n	y	n	n	1	n
RGW095	n	y	n	n	1	n
RGW096	n	y	n	n	1	n

Table 7. Group size of gray whale sightings during photo-id along Sakhalin Island, 2003.

1	58	48.33
2	38	31.66
3	18	15.00
4	4	3.33
5	2	1.66
Offshore area		
1	33	56.89
2	13	22.41
3	10	17.24
4	2	3.44
5	0	0
Piltun area		
1	25	40.32
2	25	40.32
3	8	12.90
4	2	3.22
5	2	3.22

Table 8. Frequency of re-sightings of photo-identified gray whales in the Piltun and Offshore feeding areas off the northeast coast of Sakhalin Island in 2002 and 2003.

Whale number	Number of gray whale re-sightings	
	2002	2003
RGW001	1	
RGW002	3	4
RGW003	2	
RGW004	1	2
RGW005	2	2
RGW006	2	2
RGW007	1	1
RGW008	1	1
RGW009	1	
RGW010	2	
RGW011	1	
RGW012	2	3
RGW013	1	3
RGW014	1	2
RGW015	1	
RGW016	3	1
RGW017	1	1
RGW018	3	
RGW019	1	1
RGW020	1	4
RGW021	2	2
RGW022	1	4
RGW023	1	
RGW024	2	
RGW025	1	
RGW026	2	2
RGW027	1	2
RGW028	2	2
RGW029	2	3
RGW030	2	1
RGW031	1	
RGW032	2	2
RGW033	1	
RGW034	1	1
RGW035	1	2
RGW036	1	
RGW037	1	4
RGW038	1	3
RGW039	1	1

Whale number	Number of gray whale re-sightings	
	2002	2003
RGW040	1	3
RGW041	2	2
RGW042	2	1
RGW043	1	
RGW044	1	
RGW045	1	4
RGW046	1	2
RGW047		1
RGW048		2
RGW049		2
RGW050		1
RGW051		1
RGW052		3
RGW053		3
RGW054		2
RGW055		2
RGW056		1
RGW057		1
RGW058		1
RGW059		3
RGW060		1
RGW061		2
RGW062		3
RGW063		2
RGW064		1
RGW065		1
RGW066		1
RGW067		1
RGW068		1
RGW069		3
RGW070		2
RGW071		1
RGW072		1
RGW073		2
RGW074		3
RGW075		1
RGW076		4
RGW077		1
RGW078		3
RGW079		2
RGW080		1

Whale number	Number of gray whale re-sightings	
	2002	2003
RGW081		1
RGW082		3
RGW083		1
RGW084		1
RGW085		3
RGW086		3
RGW087		1
RGW088		3
RGW089		2
RGW090		2
RGW091		1
RGW092		1
RGW093		1
RGW094		1
RGW095		1
RGW096		1
	66 sightings of 47 individuals	154 sightings of 81 individuals

Average Number of sighting per whale in 2002 - 1.40

Average Number of sighting per whale in 2003 - 1.90

Table 9. Number of re-sightings of photo-identified gray whales in the Piltun and Offshore feeding areas off the northeast coast of Sakhalin Island, 2003.

Whale number	Feeding Area	
	Piltun	Offshore
RGW002		4
RGW004		2
RGW005	2	
RGW006	2	
RGW007		1
RGW008		1
RGW012		3
RGW013		3
RGW014		2
RGW016		1
RGW017	1	
RGW019	1	
RGW020		4
RGW021		2
RGW022		4
RGW026		2
RGW027	2	
RGW028	2	
RGW029	3	
RGW030	1	
RGW032	2	
RGW034	1	
RGW035		2
RGW037	2	2
RGW038		3
RGW039	1	
RGW040	2	1
RGW041	2	
RGW042	1	
RGW045	2	2
RGW046	2	
RGW047		1
RGW048		2
RGW049	2	
RGW050	1	
RGW051	1	
RGW052	3	
RGW053		3
RGW054	2	
RGW055		2
RGW056	1	
RGW057		1
RGW058	1	
RGW059	3	
RGW060		1
RGW061		2
RGW062	2	1
RGW063	2	
RGW064	1	

Whale number	Feeding Area	
	Piltun	Offshore
RGW065	1	
RGW066	1	
RGW067	1	
RGW068	1	
RGW069		3
RGW070	2	
RGW071		1
RGW072		1
RGW073	2	
RGW074		3
RGW075	1	
RGW076	4	
RGW077	1	
RGW078	3	
RGW079	2	
RGW080	1	
RGW081	1	
RGW082	3	
RGW083	1	
RGW084	1	
RGW085	3	
RGW086	3	
RGW087	1	
RGW088		3
RGW089		2
RGW090		2
RGW091		1
RGW092		1
RGW093	1	
RGW094	1	
RGW095	1	
RGW096	1	
	85 whale sightings	69 whale sightings

In the Piltun area, 51 individual whales were identified
In the Offshore area, 34 individual whales were identified
There were in total, 154 sightings of 81 individual whales in both the Piltun and Offshore feeding areas
During the study period, four whales were sighted (RGW037, RGW045, RGW040, RGW062) in both feeding areas.

Table 10. Feeding areas where individual gray whales were observed off northeastern Sakhalin Island in 2002 and 2003.

Whale number	2002	Piltun/Offshore	2003	Piltun/Offshore
RGW001	2002_09_14	Offshore		
RGW002	2002_09_14	Offshore	2003_08_27	Offshore
	2002_09_11 2002_09_23	Offshore Offshore	2003_08_28 2003_09_05 2003_09_08	Offshore Offshore Offshore
RGW003	2002_09_14 2002_09_24	Offshore Offshore		
RGW004	2002_09_14	Offshore	2003_08_27 2003_09_06	Offshore Offshore
RGW005	2002_09_23	Offshore	2003_08_25 2003_09_18	Piltun Piltun
RGW006	2002_09_16 2002_09_24	Offshore Offshore	2003_08_24 2003_09_02	Piltun Piltun
RGW007	2002_09_16	Offshore	2003_08_18	Offshore
RGW008	2002_09_16 2002_10_12	Offshore Offshore	2003_09_18	Offshore
RGW009	2002_09_16 2002_09_17	Offshore Offshore		
RGW010	2002_09_23	Offshore		
RGW011	2002_09_24	Offshore		
RGW012	2002_09_24 2002_10_10	Offshore Offshore	2003_08_18 2003_08_27 2003_09_07	Offshore Offshore Offshore
RGW013	2002_09_23	Offshore	2003_08_28 2003_09_05 2003_09_13	Offshore Offshore Offshore
RGW014	2002_09_24	Offshore	2003_09_06 203_09_10	Offshore Offshore
RGW015	2002_09_24 2002_10_11	Offshore Offshore		
RGW016	2002_09_23 2002_09_24 2002_10_11	Offshore Offshore Offshore	2003_09_07	Offshore
RGW017	2002_09_24 2002_10_12	Offshore Offshore	2003_09_04	Piltun
RGW018	2002_09_24	Offshore		
RGW019	2002_09_28	Piltun	2003_08_25	Piltun
RGW020	2002_09_17 2002_09_23 2002_09_24	Offshore Offshore Offshore	2003_08_07 2003_08_27 2003_09_05	Offshore Offshore Offshore

Whale number	2002	Piltun/Offshore	2003	Piltun/Offshore
			2003_09_08	Offshore
RGW021	2002_09_24	Offshore	2003_08_07 2003_08_18	Offshore Offshore
RGW022	2002_09_24 2002_10_10	Offshore Offshore	2003_08_27 2003_08_28 2003_09_05 2003_09_10	Offshore Offshore Offshore Offshore
RGW023	2002_09_27	Piltun		
RGW024	2002_09_28 2002_10_07	Piltun Piltun		
RGW025	2002_09_28	Piltun		
RGW026	2002_09_28 2002_10_10 2002_10_11	Piltun Offshore Offshore	2003_09_07 2003_09_13	Offshore Offshore
RGW027	2002_09_28 2002_10_07	Piltun Piltun	2003_08_24 2003_08_25	Piltun Piltun
RGW028	2002_10_07	Piltun	2003_08_25 2003_09_03	Piltun Piltun
RGW029	2002_10_11	Offshore	2003_08_24 2003_08_25 2003_09_18	Piltun Piltun Piltun
RGW030	2002_10_07	Piltun	2003_09_18	Piltun
RGW031	2002_10_07	Piltun		
RGW032	2002_10_07 2002_10_15	Piltun Piltun	2003_08_15 2003_09_03	Piltun Piltun
RGW033	2002_10_07	Piltun		
RGW034	2002_09_23 2002_09_24	Offshore Offshore	2003_08_25	Piltun
RGW035	2002_09_23	Offshore	2003_09_05 2003_09_09	Offshore Offshore
RGW036	2002_09_23 2002_09_24	Offshore Offshore		
RGW037	2002_09_23	Offshore	2003_08_15 2003_09_07 2003_09_13 2003_09_19	Piltun Offshore Offshore Piltun
RGW038	2002_09_23	Offshore	2003_09_05 2003_09_07 2003_09_13	Offshore Offshore Offshore
RGW039	2002_10_10 2002_10_12	Offshore Offshore	2003_08_25	Piltun
RGW040	2002_10_10	Offshore	2003_08_24	Piltun

Whale number	2002	Piltun/Offshore	2003	Piltun/Offshore
			2003_08_25 2003_09_08	Piltun Offshore
RGW041	2002_10_10	Offshore	2003_08_25 2003_09_19	Piltun Piltun
RGW042	2002_10_12	Offshore	2003_09_02	Piltun
RGW043	2002_10_12	Offshore		
RGW044	2002_10_15	Piltun		
RGW045	2002_09_24	Offshore	2003_08_23 2003_08_25 2003_09_05 2003_09_08	Piltun Piltun Offshore Offshore
RGW046	2002_10_12	Offshore	2003_09_04 2003_09_19	Piltun Piltun
RGW047	2002_09_17	Offshore	2003_08_28	Offshore
RGW048			200_08_27 2003_09_05	Offshore Offshore
RGW049			2003_08_28 2003_08_25	Piltun Piltun
RGW050			2003_09_04	Piltun
RGW051			2003_09_24	Piltun
RGW052			2003_08_13 2003_08_23 2003_08_25	Piltun Piltun Piltun
RGW053			2003_08_07 2003_08_29 2003_09_13	Offshore Offshore Offshore
RGW054			2003_08_25 2003_09_03	Piltun Piltun
RGW055			2003_08_28 2003_09_05	Offshore Offshore
RGW056			2003_09_03	Piltun
RGW057			2003_08_27	Offshore
RGW058			2003_08_24	Piltun
RGW059			2003_08_24 2003_09_03 2003_09_04	Piltun Piltun Piltun
RGW060			2003_08_07	Offshore
RGW061			2003_08_07 2003_09_07	Offshore Offshore
RGW062			2003_09_03 2003_09_04 2003_09_13	Piltun Piltun Offshore

Whale number	2002	Piltun/Offshore	2003	Piltun/Offshore
RGW063			2003_08_23 2003_08_25	Piltun Piltun
RGW064			2003_08_24	Piltun
RGW065			2003_09_04	Piltun
RGW066			2003_08_25	Piltun
RGW067			2003_08_25	Piltun
RGW068			2003_09_04	Piltun
RGW069			2003_08_18 2003_08_28 2003_09_10	Offshore Offshore Offshore
RGW070			2003_09_03 2003_09_04	Piltun Piltun
RGW071			2003_09_18	Offshore
RGW072			2003_08_18	Offshore
RGW073			2003_09_03 2003_09_18	Piltun Piltun
RGW074			2003_08_18 2003_08_28 2003_09_05	Offshore Offshore Offshore
RGW075			2003_08_15	Piltun
RGW076			2003_08_13 2003_08_25 2003_09_03 2003_09_18	Piltun Piltun Piltun Piltun
RGW077			2003_08_25	Piltun
RGW078			2003_08_13 2003_09_03 2003_09_04	Piltun Piltun Piltun
RGW079			2003_08_25 2003_09_03	Piltun Piltun
RGW080			2003_08_25	Piltun
RGW081			2003_08_25	Piltun
RGW082			2003_08_15 2003_08_25 2003_09_03	Piltun Piltun Piltun
RGW083			2003_08_25	Piltun
RGW084			2003_08_25	Piltun
RGW085			2003_08_25 2003_09_03 2003_09_18	Piltun Piltun Piltun
RGW086			2003_08_25 2003_09_03	Piltun Piltun

Whale number	2002	Piltun/Offshore	2003	Piltun/Offshore
			2003_09_18	Piltun
RGW087			2003_08_25	Piltun
RGW088			2003_08_14 2003_08_18 2003_08_28	Offshore Offshore Offshore
RGW089			2003_08_18 2003_09_07	Offshore Offshore
RGW090			2003_09_08 2003_09_13	Offshore Offshore
RGW091			2003_09_18	Offshore
RGW092			2003_08_07	Offshore
RGW093			2003_08_13	Piltun
RGW094			2003_09_18	Piltun
RGW095			2003_08_13	Piltun
RGW096			2003_08_15	Piltun

Table 11. Sightings of individual whales, females with calves, body condition, and skin condition, 2003.

Whale number	2003	Cow/calf	Body condition	Skin condition
RGW001			Class 0	
RGW002	x		Class 1	
RGW003			Class 0	
RGW004	x		Class 0	
RGW005	x	Cow	Class 2	
RGW006	x		Class 0	
RGW007	x		Class 0	
RGW008	x		Class 3	
RGW009			Class 0	
RGW010			Class 0	
RGW011			Class 0	
RGW012	x		Class 1	
RGW013	x		Class 1	
RGW014	x		Class 2	
RGW015			Class 0	
RGW016	x		Class 0	
RGW017	x		Class 0	
RGW018			Class 0	
RGW019	x	Cow	Class 2	
RGW020	x		Class 2	
RGW021	x		Class 0	
RGW022	x		Class 0	
RGW023			Class 0	
RGW024			Class 0	
RGW025			Class 0	
RGW026	x		Class 1	
RGW027	x	Cow	Class 2	m2
RGW028	x	Cow	Class 3	m2
RGW029	x		Class 0	m3
RGW030	x		Class 0	
RGW031			Class 0	
RGW032	x		Class 0	
RGW033			Class 0	
RGW034	x	Cow?	Class 0	m1
RGW035	x		Class 0	
RGW036			Class 0	
RGW037	x		Class 0	
RGW038	x		Class 0	
RGW039	x	Cow	Class 2	
RGW040	x		Class 0	
RGW041	x	Cow	Class 3	
RGW042	x	Cow	Class 2	
RGW043			Class 0	
RGW044			Class 0	
RGW045	x		Class 1	
RGW046	x		Class 2	
RGW047	x		Class 0	
RGW048	x		Class 0	
RGW049	x		Class 0	m1

Whale number	2003	Cow/calf	Body condition	Skin condition
RGW050	x		Class 0	
RGW051	x		Class 2	m2
RGW052	x		Class 0	m2
RGW053	x		Class 0	
RGW054	x	Calf ?	Class 0	
RGW055	x		Class 0	
RGW056	x	Cow ?	Class 0	
RGW057	x		Class 0	
RGW058	x		Class 0	
RGW059	x		Class 0	from m1to m3
RGW060	x		Class 0	
RGW061	x		Class 0	
RGW062	x		Class 0	
RGW063	x		Class 0	
RGW064	x	?	Class 0	
RGW065	x		Class 0	
RGW066	x	Cow	Class 2	
RGW067	x		Class 0	
RGW068	x	?	Class 0	
RGW069	x		Class 0	
RGW070	x	?	Class 0	
RGW071	x		Class 2	m1
RGW072	x		Class 0	
RGW073	x	Calf ?	Class 0	
RGW074	x		Class 2	
RGW075	x	?	Class 0	
RGW076	x	?	Class 0	
RGW077	x	?	Class 0	
RGW078	x	Calf	Class 0	
RGW079	x	Calf	Class 0	
RGW080	x	Calf	Class 0	
RGW081	x	Calf	Class 0	
RGW082	x	Calf	Class 0	
RGW083	x	Calf	Class 0	
RGW084	x	Calf	Class 0	
RGW085	x	Calf	Class 0	
RGW086	x	Calf	Class 0	
RGW087	x	Calf ?	Class 0	
RGW088	x		Class 1	
RGW089	x		Class 0	
RGW090	x		Class 0	
RGW091	x		Class 0	
RGW092	x		Class 0	
RGW093	x		Class 0	
RGW094	x		Class 0	
RGW095	x		Class 0	
RGW096	x		Class 0	